PACKET & COMPUTERS

Digital Amateur Radio

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Getting Started with TCP/IP

[This series of articles explains how to set up a working amateur TCP/IP station. This first installment will sell you on the idea; next month we'll get started with the software itself. The software needed is all available free from many sources (reliable ones will be listed where available). Much of it will be available from the 73 BBS (603/924-9343), though those of you with access to Internet FTP are much better off using it when possible. Some of this first installment is a review of things you may have seen before—for this I apologize. I wanted to be sure that the series was complete.]

So many of you have written—by paper mail and electronically—asking about TCP/IP and ham radio that I have decided I had better write something about how to do it before you start showing up at the door. This series of columns is designed to give you an introduction to TCP/IP over radio, and some how-to-do-it information. The BEST way to get started in TCP/IP is to find someone who is already using it, but I'll do my best to explain the ins and outs to the shy and isolated out there.

What is TCP/IP?

TCP/IP (Transport Control Protocol/Internet Protocol) is a networking scheme developed by ARPA (The DoD's Advanced Research Projects Agency) to make possible the huge collection of computers, cables, routers, and all sorts of other boxes known as the "Internet." The Internet (note the big "I"), is worldwide and carries a mind-boggling amount of data each day. Nearly every university, large company, small technology company, and government agency is connected to the Internet.

Amateur radio is also connected to the Internet, and amateurs worldwide use the resources available there for communications and database services. In fact, as amateurs we have our own network: 44.xx.xx.xx. Any IP address starting with "44" is some sort of amateur station. (We'll look at how addressing works later.) This 44.xx.xx.xx network lets amateurs send mail to (and connect to) stations all over the world. Internet-based services such as the Ottawa converse bridge—which allows real-time chat among hams from all over the world—and the Call Sign server at SUNY Buffalo—containing up-to-date callsign records for all US hams—count on the landline connectivity of the Internet to bring you their services.

Some amateurs will tell you that TCP/IP is not ham radio because it uses landline-based resources. To these self-appointed guardians of the ether I say, "Phooey." (Pretty eloquent, eh?) If you don't like it, don't use it—but leave those of us who want to move into the 20th century alone. Those of you running full-service PBBSs take note: The Internet moves packet traffic—fast! More and more stations acting as gateways from the landline-based Internet to the various radio LANs across the country mean fast, error-free routes for your forwarding, if you know where to tie in.

All of these resources and more, are available through the TCP/IP *protocol suite*. TCP/IP is a *protocol*—a set of rules—by which communications of various types can be accomplished. If you are familiar with the idea of "diplomatic protocol"—the set of rules that govern the behavior of government representatives dealing with each other—then you have some idea of what I am talking about. With TCP/IP, stations have a way of contacting each other, establishing a communications channel, and packaging data for transmission.

What About Amateur TCP/IP Over Radio?

In 1989, Phil Karn KA9Q released a program called NOS to the ham community. This program was a first attempt at implementing TCP/IP for use on IBM-PC compatible machines for use over radio. It was—and in many respects still is—an experiment. KA9Q's NOS still provides the *kernel*—a technical term for the heart of an operating system—for the various implementations of TCP/IP hams use today. Since Phil provided the source code to NOS, many ham programmers took the torch and began to develop variants. Today, the resemblance to the original can be remote, but we owe thanks to Phil for his original work—it started a revolution.

Two things make TCP/IP a very powerful networking scheme for amateur radio. One we have already discussed—the wealth of the Internet. When we use TCP/IP over the air, the use of the landline-based Internet resources is automatic and transparent—like going to a cafe in France and ordering in French. The other is the protocol itself. TCP/IP is based on the idea of services. Each of its various features is a *service*, and is accessed through a *port* or *socket*. This arrangement makes everyone both a client (user) and a server (provider) if they want to be.

TCP/IP Services

There are four services which amateurs will find themselves using most frequently. These provide ways of connecting to other stations and transferring data. These services are the same no matter how you get to them—phone line, Ethernet network, or radio.

Telnet

The telnet service is the workhorse of the TCP/IP environment. Telnet allows a client to start a terminal session at a remote server across the network. In other words, you can login to a remote machine—wherever it happens to be—if it is reachable from your network. In the ham community, telnet is generally reserved for accessing database servers and the like. (See Figure 2 for an example. Telnet was used to reach this Internet resource.)

Telnet can also be used to login to another ham's station in order to use the mailbox there or other resources that might be provided. To continue the call server example, some NOS implementations now support CD-ROM-based callbooks. This could be accessed via telnet.

FTP

The File Transfer Protocol Service allows clients to download or upload files (binary or text) from an FTP server. This is an interactive system and allows the client to change directories, list them, and select file(s) to receive. Batch downloads are supported. If you have tried to download files from an AX.25 station you know it can be frustrating. FTP works like a charm. Recently, a friend downloaded about a quarter of a megabyte of files from my machine—at 1200 baud—in about an hour.

Finger

The finger service allows a client to get information about a particular system or user. The command:

```
Conference @ IndianaU  Type /HELP for help.
/w
User     Host         Via      Channel  Time    Personal
n1ewo    IndianaU              0        0:12    Jeff in Franklin IN
pe1mvj   westland     Ottawa   0        0:12
n8rhv    Detroit_MI   Ottawa   0        0:10
ve3wzs   TorontoBBS   Ottawa   0
n5uhb    LasCruces    Ottawa   44       0:07
n8fkv    Detroit      Ottawa   5729     0:01    Ken in Livonia, MI
dg3mkc   westland     Ottawa   5729     0:00
dl3ned   westland     Ottawa   0        0:00
n8lfj    Detroit      Ottawa   5729     23:56   Ian - Livonia,
                                                 Michigan
ke8mk    Detroit_MI   Ottawa   5        23:54   Frans Rochester
(STBY ON7KO)
k5di     LasCruces    Ottawa   44       23:54
vk3azq   OzHub        Ottawa   0        23:52   Peter Melbourne
                                                 Australia
wb8jkw   Detroit      Ottawa   0        23:51
ve3tle   TorontoBBS   Ottawa   0        23:49
n8taq    Detroit      Ottawa   5729     23:48   David in West
                                                 Bloomfield MI
n5faz    LasCruces    Ottawa   44       23:45   paul el paso, tx
vk4knt   Brisbane     Ottawa   0        23:37
wb4hin   Ottawa       Ottawa   0        23:35
aa5df    LasCruces    Ottawa   44       23:32   Tim doing homework
ve3kpb   TorontoBBS   Ottawa   44       23:18   Paul in Oshawa
ve3uzg   Vancouver    Ottawa   0        22:48   Art in Ottawa
kb9fus   BBS@k9iu.ampr.org
***
<ve3wzs>: Is anyone receiving my msg? I have just registered as
a user & not
quite sure
<ve3wzs>: how things work.Mike VE3WZS
<ve3uzg>: rgr 3wzs, copy in Ottawa..
```

Figure 1. A typical Sunday afternoon on the converse bridge. It's very late in Europe, or you would see more stations from there. Thanks to the Internet, local converse bridge programs from all over the world are linked together in a big party line. See the text for more.

```
*** connected to 128.205.32.2:2000
Callbook v1.3  Bug reports to bowen@cs.buffalo.edu  Type
'help' for help
>> call w2nsd
Call-Sign: W2NSD                    Class: ADVANCED
Real Name: WAYNE GREEN II           Birthday: SEP 3, 1922
Mailing Address: WGE CENTER, PETERBOROUGH, NH  03458
Valid From: AUG 11, 1987            To: AUG 11, 1997
```

Figure 2. The Call Server at SUNY Buffalo provides up-to-date callsign information. Here we look up an obscure callsign to test the database. This is one way amateurs take advantage of landline-based networks. See the text for more.

finger n1ewo@k9iu.ampr.org

will cause the client machine to connect to the finger server at K9IU and make an inquiry about N1EWO. K9IU will then return an informational message about the user N1EWO, providing an informational message whose content is dependent upon K9IU's configuration.

Finger can also be used to provide other sorts of information. For example:

finger weather@iugate.ucs.indiana.edu

returns a weather report for Central and South Central Indiana.

Converse

This service is VERY popular. You can see an example screen from the Ottawa converse bridge in Figure 1. The converse bridge can be a local service, or it can be *linked* with other bridges over whatever comm link is available. This service is a great deal of fun, and can be truly useful for emergency nets when administered properly. (Those of you who have Internet connections already will find the bridge at 44.135.96.7 3600. You must connect from the amateur net: 44.xx.xx.xx. Connections attempts from any other net will be ignored.)

Yet Another Service . . .

One more service to mention is called SMTP (Simple Mail Transfer Protocol). Through SMTP, amateur stations can forward their own mail! No more need to login to some remote station and read your mail; SMTP and its cousin POP (Post Office Protocol) will allow every ham to be his own postmaster.

SMTP will automatically forward, through a specified route, any mail addressed to any amateur it knows. It happens transparently, and so easily it seems like magic. With SMTP, you create the mail ON YOUR MACHINE. That's right, you don't login to another machine—you use your own. That is the way things *should* work.

POP is an alternative to SMTP and makes sense for those who cannot dedicate a machine to running TCP/IP all the time. Like SMTP, POP allows you to use your machine to create messages, and will route them automagically. Unlike SMTP, though, POP calls a post office (another system on your network) and uses a batch technique to send and receive messages. This way, you can check for mail at your post office whenever you start up your system.

Once again we are in France speaking French—these two protocols come from the Internet, and so work perfectly across it and with the machines on it. This means that Internet resources, like list servers which automatically route messages to special interest groups, are available the ham.

"If you don't like it, don't use it—but leave those of us who want to move into the 20th century alone."

OK, OK, I'm Convinced—Now What?

I told you this was a series of articles, and that I would help you get started, so here it is. We will be working with a piece of software called JNOS. This is a variation of KA9Q's NOS, and is available from several sources. The version you will need is 1.08c. I chose this software for several reasons, and there will be those who will argue that it is not the best choice. Here are some of my reasons:

1. It is stable, and still a "live" product. Johann WG7J is still working furiously on new versions, so it will grow as TCP/IP does.

2. It has a decent user interface, but also provides everything that you need to run a full-service PBBS. This way I can help both the PBBS operator *and* the average user to get started.

3. I like it, I use it myself.

So, to get started you have to have the software. Those of you who have Internet FTP access will find the program at uscd.edu for anonymous FTP. Those who do not will find it on the *73* BBS, in the packet files area. You will also find the program on ham BBSs around the country. Remember, you want version 1.08c. You will also need a TNC that will operate in KISS mode. If you are unsure of your particular TNC, check the manual. Those of you running BayCom (or equivalent) modems *may* be able to run JNOS with a special driver. If you want to try, mail me and I'll explain.

Your homework is:

Get version 1.08c of JNOS.

Get a valid TCP/IP address. To do this, contact your local ampr coordinator and ask for one. If you need to find out who your coordinator is, send me mail at either:

Internet:
jsloman@bix.com
or
packet:
N1EWO@NØARY.#NOCAL.CA.USA.NOAM

Next month, we'll look at how to set up the software and get that TCP/IP stuff working. 'Til then, 73 de N1EWO. 73

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PACKET & COMPUTERS

Digital Amateur Radio

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Getting Started in TCP/IP, Part 2

Last month we started a series of articles on TCP/IP over ham radio, including how to do it. The first installment explained what TCP/IP is, and why it has advantages over the more familiar AX.25 "packet" protocol that most hams use. This month we'll talk about what you need to set up a working TCP/IP station and where to get it.

TCP/IP (Transport Control Protocol/Internet Protocol) is a way of moving various sorts of data in various sorts of packages. Associated with IP" are a number of protocols for moving mail, bulletins, and data files—as well as ways of connecting or real-time discussions. We'll explore all of these in this series. First, of course, you need to be able to connect to the world of IP. What do you need to do this?

The "normal" packet radio protocol (AX.25) is usually built right into the hardware that a ham buys for "packet." The TNC (Terminal Node Controller) has a small processor and some firmware in ROM (Read Only Memory) that can talk right to a dumb terminal and radio. All that is needed is to connect the pieces together with the appropriate cables and the station is on the air.

While TCP/IP uses pretty much the same pieces as an AX.25 station, the jobs get switched around a bit. Although the AX.25 station frequently employs a computer as the dumb terminal, it doesn't need to. Anything that can "speak" RS-232 will work. For an IP station, though, the computer takes over most of the "thinking" from the TNC. The IP software puts the TNC into KISS (Keep It Simple, Stupid.) mode and handles all of the protocol business.

The Computer

Just how much machine do you need to run IP? The answer to this question varies a great deal, depending upon what you intend to do. TCP/IP stations run the gamut from single-user setups that only operate as clients—users of other stations—to full-blown multi-service hosts (PBBS). Nearly any computer is capable of operation in the first category. Various ons of NOS (the original TCP/IP software from Phil Karns KA9Q) are available for just about every personal computer, and for UNIX on many platforms. Because of the overwhelming likelihood that you are using an MS-DOS-based computer, that is what we will concentrate on. However there are also versions for the Amiga (another popular computer among hams) readily available. In addition, the program we will discuss most—JNOS from WG7J—is available in source code form. If you can use a C compiler, you might just be able to whip up a version for your own machine.

NOS and its variations are designed to be multitasking. That is, they run several *processes* simultaneously. In practice this means that there are separate, tiny programs doing a variety of things—apparently—at the same time. Since there is only one processor in your machine, what is really going on is a time sharing affair. Process 1 uses the CPU, then process 2, then maybe process 3 or even 1 again. From the user level the events that result from these processes appear to occur at the same time.

All this activity requires as much memory as it can get. Unfortunately, the versions of NOS that you can get today are not capable of using extended or expanded memory. They *will* use as much of the first 640K as you can give them, though. So, the first requirement for the IP station PC is 640K base memory.

As you might have guessed, multitasking is very CPU-intensive as well. This means that an IP station PC will be happier with a faster CPU. The simple rule is: The faster the better. Slower CPUs will produce various sorts of errors when they are loaded down with IP activity. Remember that the IP station must listen to you and the radio at the same time as it does its housekeeping. The station's use determines this load. A full-service host will run reasonably well on a 286/12 computer, but much better on a 386/25.

The programs and data files needed to run NOS are not that large. You could conceivably run an IP station on a floppy-based machine. On the other hand, even a small hard disk is a big improvement. Also, if you intend to run a full-service host, you will probably want to offer files for FTP (File Transfer Protocol) download. You'll need someplace to keep these.

The TNC

A TNC for IP station use does not need to be anything special. Basic IP operations at 1200 baud on VHF/UHF can be done with any TNC that offers KISS mode operation. The least expensive boxes, like the PK-88 from AEA, do just fine at this. However, if you are in a high activity area, or want to run a full-service host on a "backbone," you'll want to consider fancier options.

Most activity in the digital ham radio world today run at 1200 baud. This is the normal data rate for AX.25, and is standard on just about every TNC you can buy. Higher data rates are generally more desirable, but 1200 is entrenched. The backbones, though, usually run at 9600 baud or faster. There is a trend to faster user port speeds with a considerable contingent proposing a just right to 9600 baud. How does this affect your choice of TNC? Just keep this in mind, and think about something that can be upgraded to a higher speed, even if you don't do it now.

The Radio

As far as radio choice is concerned, IP adds nothing to the requirements. A good choice for packet is a good choice for IP. When looking for a radio, keep these requirements in mind:

Choose something modern. While a used radio is just fine, it should be a newer model if possible. Digital radio requires the radio to switch from receive to transmit very frequently. The delay in going between modes is called "switchover" time. This delay needs to be as short as possible to ensure good performance.

Choose something powerful. Though you *can* use a handheld for packet or IP, it is a risky proposition. For a radio LAN (Local Area Network) to work right, every station (called a node in LAN terminology) must be able to hear every other. With a low-powered station on the net, disruption and unreliable connections are likely. The power requirement varies with the particular LAN. The further the nodes are spread geographically, the more powerful the transmitter needs to be. If you are thinking about using an amplifier on a handheld, consider this: It may not switch fast enough to work at higher speeds. While even COR (Carrier Operated Relay) style amps usually work at 1200 baud, at higher speeds the switchover time of many amps will be too long.

Choose something sensitive. This is just the flip side of the powerful requirement. A sensitive receiver will help to improve the station's performance on the LAN.

Choose a good antenna. With good "ears" your receiver and transmitter will operate more efficiently. You need an *omnidirectional* antenna, NOT a beam. Remember, all the other stations have to be able to hear you for things to work right. A beam is only appropriate in a limited number of cases. Put the antenna up as high as you can and use good coax—remember that loss goes way up with frequency.

The Software

The rest of the articles in this series will discuss installing, configuring, and maintaining JNOS—a full-service variation on KA9Q NOS. The executable is for MS-DOS-based machines, and is frequently updated by the author, Johann WG7J. I chose to use this implementation for several reasons:

- It is popular.
- It is widely available.
- It has a stable working version with very few bugs.
- It has all the features needed for a full-service host.
- It will work as an Internet gateway.
- It has a reasonably good user interface.
- I am using it here.

JNOS offers all of the host and client services currently available for amateur TCP/IP. For the end user, it offers a decent user interface, a split-screen terminal for AX.25 connects, POP mail (more on this later), and up to nine concurrent sessions with hot key switching. For the PBBS operator, JNOS offers superb mail connectivity (normal packet mail plus SMTP and POP servers), excellent security.

My choice of JNOS should not be construed as disparaging to any other NOS implementation. There are lots out there, and all have strengths and weaknesses. Each implementation is slightly different, so I had to choose just one. If you have a machine for which JNOS is unavailable, don't fret. You can get the source and compile a version—or you can find something else that works. While another implementation will not be identical, above the detail level you will still find the information presented here useful.

Getting JNOS

We will be working with JNOS version 1.07b. I will offer two ways to get it but, with a little ingenuity, I am sure you can find it elsewhere. First, if you have anonymous FTP access to the Internet, you will find the MS-DOS executable and source at:

ucsd.edu

In the directory:

\hamradio\packet\tcpip\jnos

The files are:

jnos107b.exe (executable)
jnos107b.zip (source)
jnosdoc.zip (documentation)

Get the executable and documentation files. If you want to compile a special version, get the source. (NOTE: If you don't know what "FTP" is, don't worry—just go on to the next option.)

The second way to get the files is from the *73* BBS. Be warned that the BBS can only do 2400 baud, so this will take awhile. The *73* BBS can be reached at:

603-924-9343 (8N1)

When you connect, follow the instructions and provide the requested information. When you get to the main menu, choose "F" for file area, and "9" for packet. The executable and documentation will be there.

Next Month . . .

. . . we'll actually install the software and start to configure it. While it is not a trivial operation, I imagine many of you will be on the air at that point. In the meantime, you might just try getting on the air without my help. Don't let it frustrate you: The docs can be confusing and the setup is not intuitive. Good luck! 73 de N1EWO 73

PACKET & COMPUTERS

Digital Amateur Radio

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Getting Started with TCP/IP, Part 3

Wow! I guess you ARE interested in getting a TCP/IP station on the air. At least that is the way it looks from here. I have received *hundreds* of email requests for information about software and IP addresses. My Internet mailbox overflowed, so I lost some of the queries, and I just couldn't possibly answer all those requests—not enough time in the day. So, I'll do the best I can, and try to clear up the confusion that a transposition of letters caused in the first installment of this series, and give you the best information that I have about IP address coordinators.

In the first column I told you to get a copy of JNOS version 1.08c from USCD.EDU via anonymous FTP. Well, forget that. Here is the CORRECT information:

Location: UCSD.EDU (note the correction from USCD.EDU)

Directory: hamradio/packet/tcpip/wg7j

Filename: JNOS107B.EXE

Those of you who have managed to get later versions of JNOS, this is fine. The choice of 1.07b is based on its stability and availability, but later versions will work. Keep this in mind because this version is available in the directory noted above. The 1.07b version will be available on the *73* BBS, in the "Packet and Computers" area (8). You can reach the *73* BBS at (603) 924-9343. 2400 baud, 8N1. Note that this is a relatively large file and the slow speed of the *73* BBS should convince you to try other places first.

Uncoordinated Coordination

I thought most of you would be able to find your local AMPR coordinator, though I expected a few requests for help. Well, after receiving hundreds of messages via Internet mail, I realized that maybe some of you were having some trouble. I have to do something, but answering each of your cries for help is not a practical route. So, here (in the sidebar) is the list of the official volunteer AMPR coordinators. THIS IS ALL THE INFORMATION THAT I HAVE. I cannot tell you how to contact these people or exactly which one is the coordinator for your location.

Look on the list and take your best shot. It has been sorted by location, to make it easier for you. Also, the last column is the *subnet* for the coordinator's area. This can also be a clue for you. Find someone with an IP address and look for the matching subnet. Remember that these people are volunteers—please be friendly and courteous with your request. If you think that you might want to run more than one station, request more than one address. Though the specific information that the coordinator will need may vary from place to place, if you contact them via packet radio, try to include at least the stuff below to decrease your chance of being asked to provide more information:

Your name.

Your call.

A mailing address.

A phone number.

The county, town or city, and zip code where the station will be located.

You may have to wait a little while for a reply, try to be patient. If you want to get started, but don't yet have an address, you can use the official "test" network. This is any address in the 44.128.XXX.XXX range.

An Important Note About Packet Radio

While I always enjoy corresponding with you via packet radio, I simply cannot do business that way. Because I do not want to have even the appearance of impropriety, I just cannot answer any mail that refers to the column and then asks for help. Please, if you need help, use commercial email or paper mail. I can be reached on the Internet:

jsloman@bix.com

and by US mail:

N1EWO

P.O. BOX 636

Franklin IN 46131

Thanks for your understanding. Note, too, that I still want to hear from you on the amateur packet network. Please, just restrict this traffic to pleasantries or questions that relate to ham stuff with no reference to the column.

More Than Error Correction

Though I had planned to get started on the tutorial this month, I had to clear up the confusion caused by typos and whatnot. Now I don't want to completely frustrate those of you who have managed to get the software and an IP address, so let's take what space is left to at least begin the tutorial. (Next month will be dedicated to the tutorial.)

JNOS and Its Files

The heart of making JNOS work is a set of text files that configure the program and provide information to it. Though they all must be in good shape for things to work, the central focus is on a configuration file called AUTOEXEC.NOS. Like a combination of DOS' CONFIG.SYS and AUTOEXEC.BAT, AUTOEXEC.NOS contains hardware and software configuration information and commands for the program to carry out on startup. It is the arcane and not-so-logical stuff in this file that will make or break your station.

Unfortunately, the exact format and syntax of AUTOEXEC.NOS varies not only among implementations of NOS, but even among versions of the SAME implementation. To get you started with JNOS, we'll look at one of the most confusing and absolutely required sections of AUTOEXEC.NOS as it works with JNOS (and most other NOSs, thank goodness).

The section is reproduced here in Figure 1. These are the statement(s) that attach the communication device(s) to the program. Our example here is to connect a TNC to a comm port. Later on we'll look at more advanced stuff like Ethernet.

Any of the lines that begin with "#" are comments, and shown are lines for all four comm ports. The active one is com1, since it is not preceded by "#."

The attach command instructs the program to connect a hardware device to the program. The parameter "asy" is an abbreviation for "asynchronous," the type of communications device. The next value "0x3f8" is the base address of the communications port, you probably don't need to change the values from the standard ones listed here. Following the base address is the IRQ (interrupt). This is also a standard value for each port. The next parameter, "AX25," tells JNOS what sort of interface this will be. There are other values which we will discuss later.

The value "tnc0" is an arbitrary name that is used to refer to the interface you are creating. This name can be nearly anything, and should probably NOT be tnc0. Many users name it by frequency—01, 03, 05, etc.—to make it easier to understand what is going on. If your station will not necessarily stay on one frequency, name it anything that seems meaningful to you.

The next two numbers are buffers; don't change these until you know more. This is another advanced topic which we will discuss. The last number is the baud rate of the port. Note that it is set to 4800 here. Why? Because the program may have difficulty decoding the information from the TNC if it comes at a higher rate, but the messages from the TNC will seem intolerably slow at 1200 or 2400. This is a good compromise. One way to tell if you have the port speed set too high is the presence of corrupted or "nonsense" calls in the "just heard" list.

Keep It Simple, Stupid

The other absolute requirement for NOS to operate is that the TNC be made to operate in KISS (Keep It Simple, Stupid) mode. In this mode, JNOS takes over the operation of the TNC. There is a small script included as part of the AUTOEXEC.NOS that is designed to turn your TNC's KISS mode on (most TNC command sets require a simple "KISS ON" com-

```
# ----------ATTACH THE TNC----------
  attach asy    0x3f8 4 ax25 tnc0 2048 256 4800    # COM1
# attach asy    0x2f8 3 ax25 tnc0 2048 256 4800    # COM2
# attach asy    0x3e8 4 ax25 tnc0 2048 256 4800    # COM3
# attach asy    0x2e8 3 ax25 tnc0 2048 256 4800    # COM4
```

Figure 1. One of the critical sections of AUTOEXEC.NOS.

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Abdul-Hamid Sadka	Turkey	TA2LA	44.176
Karel Odehnal	Czech Republic	OK2XTE	44.177
Karen Tadewosyan	Russia	RA3APW	44.178
Tom Clark	Outer Space	W3IWI	44.193

mand). We will cover this part of the file next month. In the meantime, if the TNC does not seem to initialize correctly try this: Talk to the TNC with any communications program, ensuring that the communications speed (baud rate) matches the one you chose in the AUTOEXEC.NOS. Check your manual for how to get your TNC into KISS mode. Send the command(s) and exit the program. Start NOS, and you should be all set.

Next time we'll get into more meaty stuff. Sorry for the confusion—I hope it's cleared up now. 'Til then 73 de N1EWO. 73

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Getting Started with TCP/IP, Part 4

[This is Part 4 of a series on getting started with TCP/IP over amateur radio. The series uses JNOS, a KA9Q NOS implementation as the focus, though much of the information is applicable to any variation of NOS. Non-IBM-PC users will still find the information useful, though details may vary for NOS running on your platform. If you see something that varies, and would like to share tips with other users of the machine you own, please send mail and I will pass along interesting material . . . N1EWO.]

OK. I think that most of the confusion concerning versions has been cleared up; just to be sure, here is the rundown:

We will be concentrating on two versions of JNOS: 1.07b and 1.08c. These two versions are widely distributed, though some configuration details vary. Both versions are now on the *73* BBS, though the "official" version for our purposes is 1.07b. Because of differences in details, it is quite possible that "errors" will creep into the articles in this series—that is, I may miss some differences and not spell them out. If something doesn't work with the version you are using, please try to work with it a little before assuming what you read here is wrong. If you find one of these "mistakes" please send me e-mail [jsloman@bix.com] (NOT packet mail) and let me know.

If you are using a version of JNOS other than these two I can guarantee that you will find discrepancies. This does not mean that you cannot follow along with the version that you have. I may even point out some of these if I know about them. There will be changes in syntax and feature support. If you are using a version that is 1.10x(n), where n is any number, you are using an experimental version and should expect some trouble.

The Components of JNOS

Knowing the purpose of the several files that comprise JNOS is a great way to get started. Some of these files are optional, but others must be precisely correct for the program to work at all. Let's take a look at the components and how they are used.

NOS.EXE

This is JNOS itself, the executable file that does all the work. It is, of course, not optional. The exact functionality of the executable file you have can vary quite a bit. JNOS is generally distributed as source code and compiled by the end user using a C++ compiler. If you did not compile the version you are using, you cannot be sure which pieces of code were included at compile time. The generally available .EXE files are often compiled with the 8088 switch rather than 80386. This means that it will run on 8088 (PC-XT, etc.) machines as well as 386/486 machines—though perhaps a bit slower.

AUTOEXEC.NOS

This file is the heart of JNOS configuration—the entries in this file configure JNOS at startup. This file is very much like DOS's AUTOEXEC.BAT. Entries in it are treated as command line entries when the program starts. In other words, what you put in this file is—in effect—typed at the command line. The default location is in the root directory of the drive where NOS.EXE resides. This can be changed with the proper command line switch when you start JNOS, or with an entry in NOS.CFG (we'll look at this stuff later).

There are a few essential entries in the AUTOEXEC.NOS file. These are basic configuration commands. Though it is theoretically possible for you to type these commands manually each time you start the program, it doesn't make much sense to do this—it is what AUTOEXEC.NOS is for. Let's take a first pass look at the this file to help you get started. We'll take a look in more detail later in the series.

ax25

The ax25 command sets various ax25 parameters, the same as if you were programming a TNC. Among the very first things that you must have in your AUTOEXEC.NOS file is a command like:

ax25 mycall N1EWO

where N1EWO is, of course, your call. This sets the call for your station as far as the FCC and the rest of the packet world is concerned. The ax25 command does many other things which we will discuss later.

ATTACH

The ATTACH command attaches an *interface* to the NOS program. The most basic interface for ham radio use is a TNC connected to a serial port. The interface can be looked at from several levels. It is a serial port at the physical layer, and follows RS-232 standards. It is also a TNC in KISS (Keep It Simple, Stupid) mode. At the *network* layer, this interface is an ax25

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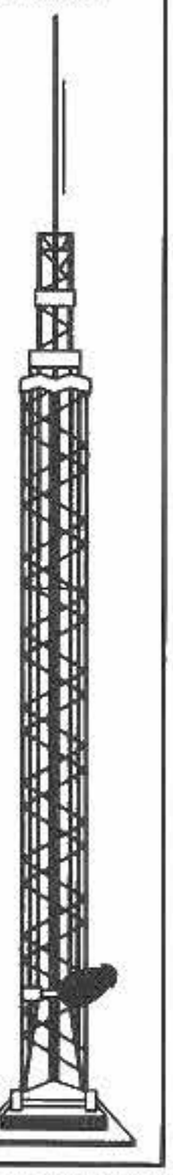

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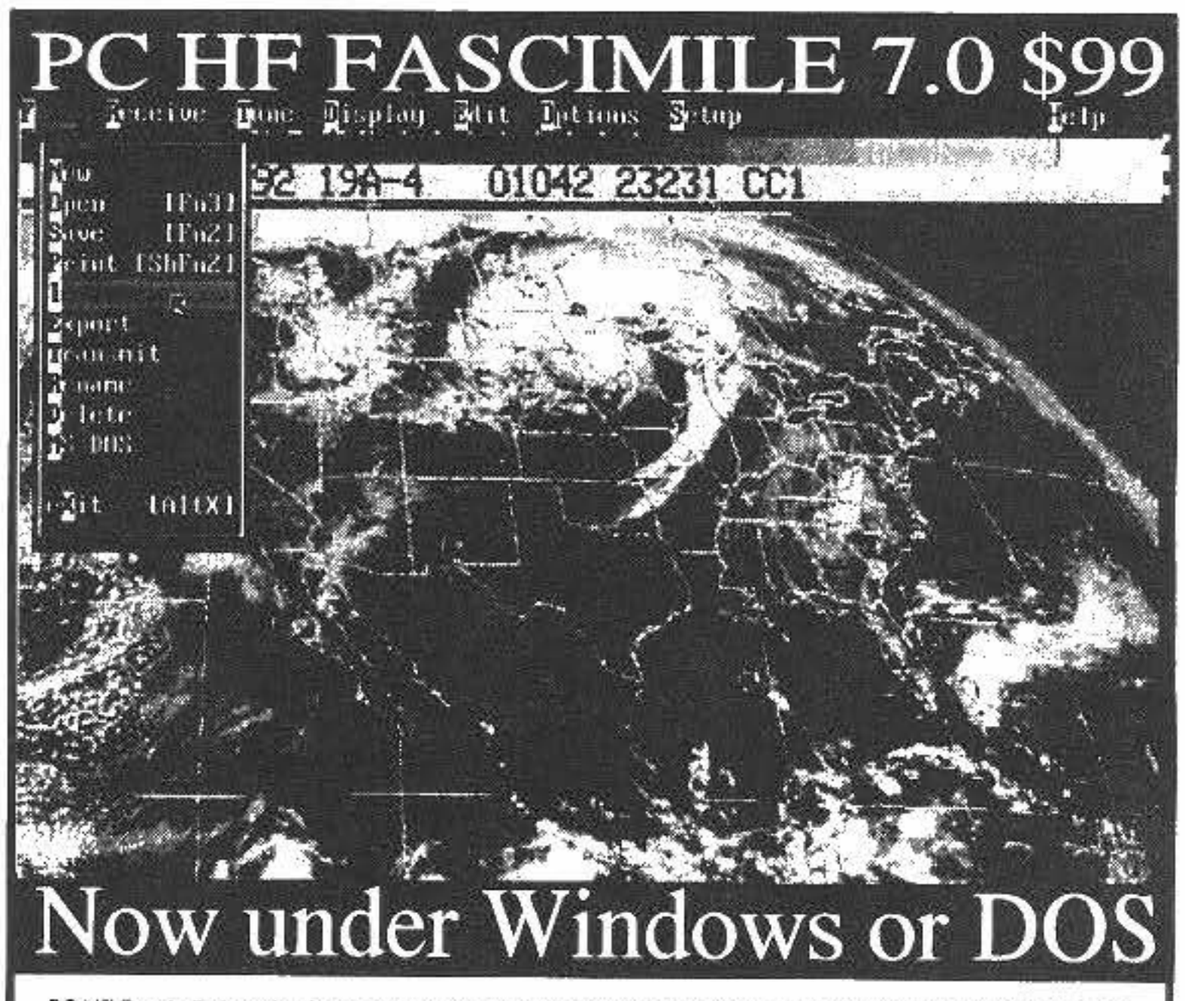

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connection, and an IP connection. At the *transport* layer the interface uses TCP and UDP—this also holds for the *session* layer. These layers are taken from the OSI network reference model. This is a generic description of networking that divides the functions required for a data network into seven "layers":

Application
Presentation
Session
Transport
Network
Datalink
Physical

This model is a tool to help think about networking. As you can see, some components may fit into more than one layer. Some networks omit some layers unnecessary for the application. If you don't follow this discussion, don't worry—it is presented for background and you don't need to understand it to make JNOS go. If you are interested in it, you will find this information discussed in depth in any good text on data networks.

Attaching any interface requires issuing an attach command with the proper command line parameters. Below is an example of attaching a KISS mode TNC to COM1: at 4800 bps:

```
attach asy  0x3f8 4 ax25 TNC0
  2048 256 4800
```

attach is the command
asy is short for asynchronous—the serial port interface
0x3f8 is the base port address for COM1:
4 is the IRQ for COM1:
ax25 specifies the interface protocol
TNC0 is the (arbitrary) name of the interface
2048 is the size—in bytes—of the buffer to allocate for this interface
256 is the MTU (Maximum Transmission Unit)—biggest packet size—in bytes
4800 is the data rate in bps

This is the structure of any attach command. JNOS supports other parameters on this command line. The first parameter, called "hardware type," supports things like Ethernet adapters and internal TNC boards. The specifics for versions and supported hardware should be found in the latest documentation for JNOS.

The second parameter, called "IO address," can be set to any valid port address, usually though it will be one of the four standard com ports:

COM1: 0x3f8
COM2: 0x2f8
COM3: 0x3e8
COM4: 0x2e8

Note that the address is specified in *hex* (hexadecimal or base 16), and is preceeded by "0x." This prefix is a convention indicating that what follows is a hex number.

The next parameter is called "vector," and is the same thing as IRQ (Interrupt ReQuest line). This is the hardware connection that is used by the port hardware to get the computer's attention when data is available. These IRQs are generally set at standard values, unless you have unusual or reconfigured hardware:

COM1: 4
COM2: 3
COM3: 4
COM4: 3

Note that ports 1 and 3 share IRQ 4, while 2 and 4 use 3—this means that ports 1 and 3 (or 2 and 4) cannot be used in pairs unless reconfigured because IRQs CANNOT BE SHARED. This is not true on MCA or EISA machines if you happen to have one, but it is the general rule. So, if you want to connect more than one TNC to your JNOS station—the software allows this easily—you will have to juggle your hardware resources to prevent conflicts.

The next parameter is called "mode" and specifies how JNOS should interact with whatever is on the other side of the serial port. In this case ax25 tells JNOS to include information to control the KISS mode TNC along with the data. Another option is SLIP (Serial Line Internet Protocol), which is designed for direct connections and so omits the TNC stuff.

Following mode is "label," an arbitrary name for the interface. This name should be representative of the interface's function on your system; it is for you—call it something that is meaningful to you.

The next parameter is "bufsize." This is the size, in bytes of the *ring buffer*, allocated for the serial port. If this number is too small, data may be lost. We'll discuss choosing the right size for this parameter later during optimization. The default of 2048 (2K) should suffice for most cases.

After bufsize is MTU. The Maximum Transmission Unit is the size of the largest data packet that your station will send on this interface. 256 is a good default value; changing this number will be discussed in the optimization section later on the series.

Finally, there is "speed" in bps (bits per second). The first consideration in setting this number is that it must match what the TNC expects on the other end of the connection. Second is the speed of your processor. The higher this number, the more interrupts to which the CPU must respond. Slower machines may lose data if the number is too high. A symptom of too high a setting is strange callsigns in the stations heard list.

Next month we'll look at other commands that you need in the AUTOEXEC.NOS file to get your station on the air. Until then, keep working to get on the air. A basic JNOS station is something you should be able to put on the air yourself. There will be three or four more parts to this series, and I'd hate to think that you would wait that long to get on the air. 73 de N1EWO. 73

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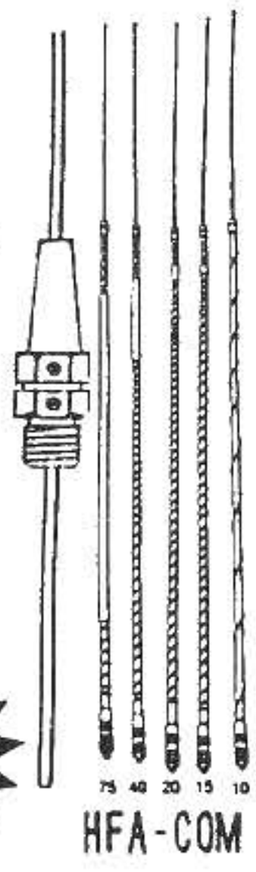

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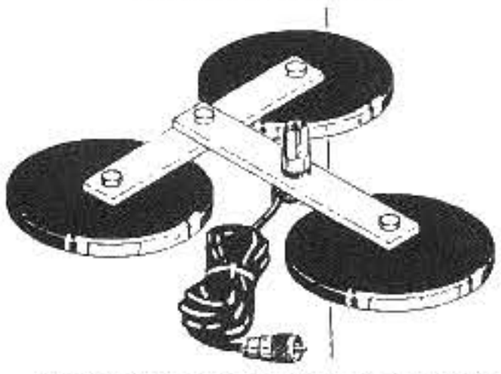

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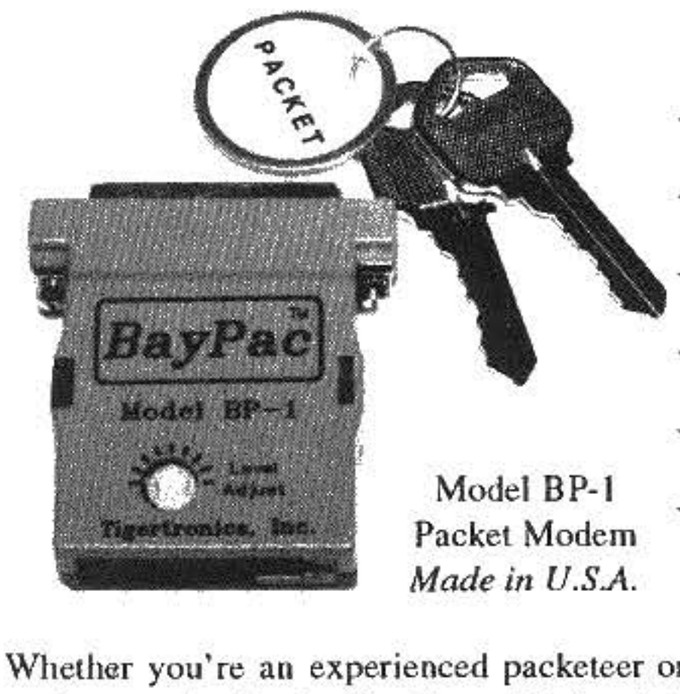

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Getting Started with TCP/IP, Part 5: AUTOEXEC.NOS

[This column is Part 5 in a series on using amateur TCP/IP. In this series we are using KA9Q NOS in the form of JNOS (WG7J) version 1.07b or 1.08c. The software is available in the "Packet & Computers" area of the 73 BBS: (603) 924-9343, 300-2400 baud, 8 data bits, no parity, one stop bit.]

The primary configuration file for NOS is AUTOEXEC.NOS. This file functions much like DOS's AUTOEXEC.BAT. Entries in it are executed as if typed in at the JNOS command prompt. JNOS also offers a facility to include other files in AUTOEXEC.NOS by reference.

Some entries in AUTOEXEC.NOS are position-dependent—that is, certain statements must precede them to get the expected result. For the most part, though, the order in which statements appear in the file is arbitrary. In order to easily learn about the AUTOEXEC.NOS file, we'll divide it into logical sections. These sections are not enforced by JNOS—they are a convenience for us.

Let's take a look at the conventions used in the AUTOEXEC.NOS file. Below is a typical entry:

```
isat        yes        # 286/386 clock
```

"isat" is the parameter that we are setting (this tells JNOS that you are using a 286 or better clock). Separated by an arbitrary *white space*—spaces or tabs—is, in this case, a binary switch. It is called "binary" because it is either on or off. Most JNOS commands that use binary switches accept a variety of values: y, yes, true, on, 1, set, enable (to turn a feature on); and n, no, false, off, 0, clear, disable (to turn one off). The "#" precedes a comment. Whatever follows a # on the line will be ignored by JNOS as it processes the file.

Creating a Working AUTOEXEC.NOS

Let's start our look at the entries that are necessary to produce a working JNOS station. These are the entries that create a basic configuration which will let you get your JNOS station on the air

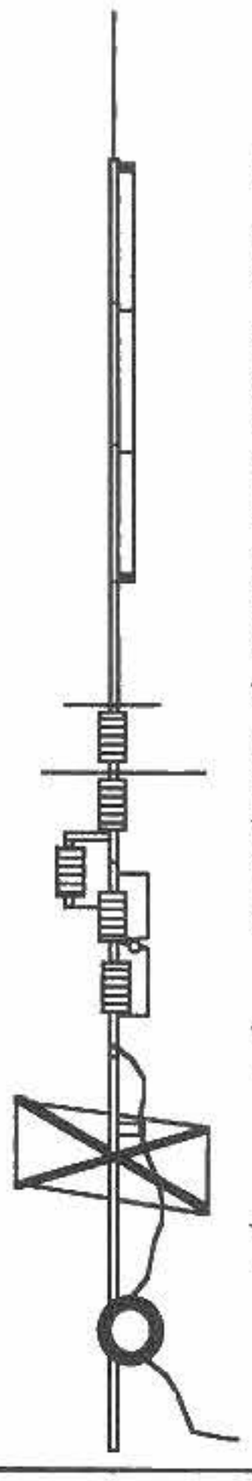
DOMAIN

The domain command sets or displays parameters related to mapping between names (e.g.: n1ewo.ampr.org) to numerical (e g.: 44.48.70.21) addresses, and provides a way to add DNSs (Domain Name Servers) to your configuration.

This translation service is very important. To understand why, let's take a look at the two types of addressing. Numerical addressing is the "native" way that TCP/IP determines how to find a device on a network. Here's how it works: Each numerical Internet address consists of four bytes. Each byte—eight bits of information—can have one of 256 values. When an Internet address is written it is usually done by writing the value of each byte (in decimal notation—that is base 10 or "normal") separated by a dot (.). Internet addresses come in three classes—A, B, and C. Class A addressing uses just the first byte to distinguish the network; the last three bytes are for the "host" or device version. This sort of addressing is used when there are few networks and lots of devices connected. Class B uses the first two bytes for the network, which balances the number of available network and device address. Class C (you guessed it!) uses the first three bytes for the network address, the last byte for device addresses.

The most common addressing class used in the amateur TCP/IP world is C. Amateur addresses always start with 44. This is the address for the *domain* AMPR.ORG; the *name* ampr.org amps to the addresses that lie in the 44.xx.xx.xx address space. All amateur addresses assigned by IP coordinators are sent to a host at the University of California at San Diego called mirrorshades.ucsd.edu. This host acts as a *router*. This means that any time there is traffic anywhere on the Internet that starts with 44, it is sent to mirrorshades, which looks at the address and sends it on its way to the correct gateway.

The second byte in an amateur Internet address points to a particular region of the world. For example, 44.48.xx.xx is somewhere in Indiana, because of the 48. The 48, in this case, is the Indiana *subnet*. How the next two bytes are used is up to the local IP coordination mechanism. Here in Indiana, we have regional subnets (yes, you can have subnets in subnets). I am located in subnet 70. This makes my first three bytes: 44.48.70; add 21 to this and you have my complete address: 44.48.70.21. 21 is the host (I also call this "device," since it could be any sort of networked hardware) portion of the address. There



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are up to 255 devices on the 70 subnet. Why not 256? Because, by convention, hosts are never assigned 0 addresses; these are reserved for networks. The address 44.0.0.0, for example, addresses the traffic to the ampr *network*.

OK, so now you have some idea of what the numerical address is and how to read it. What about the name stuff? Obviously the numerical address is not particularly user friendly. It is also absolute—that is, always points to the same machine or device. Names get around both of these things. First, it is a lot easier to remember n1ewo.ampr.org than 44.48.70.21. The first part is my call; the second is the name of the amateur Internet subnet. This formula works for most amateurs on Internet—though some use SSIDs (Secondary Station Identifiers, e.g.: N1EWO-1) or other names.

The other advantage of names is that where they map can change arbitrarily. For example, a while ago, in this column, I reported on K9IU and its Internet<—>amprnet gateway. In the piece I specified K9IU's numeric (Internet) address. Because of this, when the sysops of K9IU had to make changes to their hardware configuration, which moved the gateway to a new Internet address, they had to do a bunch of fancy footwork. Had I instead just told you about K9IU.AMPR.ORG, it would have been a simple matter for the sysops to tell mirrorshades that this name now mapped to the new address.

So this domain stuff is pretty important. Most of your domain name services will come from looking at a local file called DOMAIN.TXT—this file contains names and their associated Internet addresses. To do this name-to-address mapping, JNOS looks in the DOMAIN.TXT file and finds the entry that matches the name it is working with. This means opening the file, and parsing (reading and interpreting) it—a very (time-) costly operation. A TCP/IP conversation involves lots of packets, each with a header that might require this translation. Because of this, setting up the domain services can have an effect on performance.

The first setting we'll look at is the *cache* size. A cache is a space in memory which is set aside to store some particular sort of memory object—in this case, a name<—>address mapping. When JNOS needs to make a translation it will first look in the cache (much faster than opening and reading a file) and use what it finds there. If you have recently communicated with a station this information may reside in the cache and speed things up. The cache size is set with the command:

```
domain cache size <n>
```

where domain is the command, cache size is the subcommand, and <n> is the number of entries to be cached. The limit is based on available memory and the default is 5. You should set this parameter to a number large enough so that you usually don't have to open your DOMAIN.TXT file. You can tell if this is happening by watching for disk activity when your station tries to *resolve* a name.

The next domain subcommand of interest is "translate." This subcommand determines if JNOS will try to convert numerical addresses to names whenever it displays them (in trace mode, for example). This can be a real CPU hog, so unless you really need it, turning it off is a good idea. To do this, the entry should be:

```
domain translate off
```

The last domain subcommand for the AUTOEXEC.NOS needs some explanation. It involves the use of a Domain Name Server, or DNS. If you live within radio earshot of a real Internet gateway this may be of use to you. A DNS is a machine that has a comprehensive DOMAIN.TXT file. When you try to use a name that does not appear in your own DOMAIN.TXT file, JNOS will contact a DNS that you have specified. If the DNS has the name you are looking for, JNOS will add it to your DOMAIN.TXT. This is a great service if you can take advantage of it. The command looks like this:

```
domain addserver <host> <time
out>
```

where domain is the command, addserver is the subcommand, <host> is the host ID of the DNS, and <timeout> is an optional timeout in seconds.

You can control whether your station updates the local DOMAIN.TXT based on the DNS server response with:

```
domain update <boolean>
```

where "domain" is the command, "update" is the subcommand, and "<boolean>" is on, off or one of the equivalents mentioned earlier.

Finally, you can turn your own station into a DNS using the command:

```
domain dns on
```

where "domain" is the command, "dns" is the subcommand, and "on" enables the DNS server built into JNOS—the default is off.

Next month we'll continue with AUTOEXEC.NOS, taking a look at interface configuration. (NOTE: A working JNOS AUTOEXEC.NOS file is available on the *73* BBS in the "Packet & Computers" file area. The file is named: JNOSAUTO.TXT.) 73

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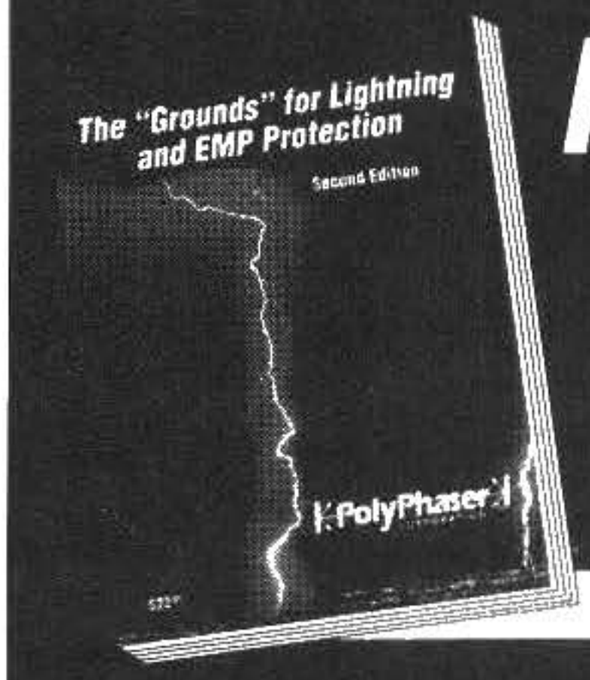

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What Are We Doing Here?

As you saw in last month's column, I was attacked by the oriental death flu. Well, I am back to about 90% capacity and I'd like to use this month's column to talk a little about JNOS, and some other things. First, last month's column included an example of an AUTOEXEC.NOS file from a working station. It should get you well on the way to a working station with just a little editing. Also included last month was a table describing how to give users permission to access various functions of your JNOS station. In both cases, there are some version-dependent differences—you'll need to sort out what is up with your station by reading error messages and observing behavior.

Catching Up

Many of you may be reading this column for the first time and have no clue what the first paragraph of this column is about. For you, let's take a quick look at what has been going on here for the past few months. Amateur packet radio is usually thought of as AX.25—Amateur X.25. This is a version of the X.25 protocol used in hardwired networking adapted to use on radio channels. This protocol was developed quite some time ago—as ham radio technology goes—and was made possible for the average amateur by the TAPR TNC1. TAPR is a group of amateurs in Tucson who decided to develop the hardware to make amateur packet radio a reality.

The TNC1 was the first hardware and firmware system that understood AX.25. It was, in effect, a dedicated computer system-which could be connected to a "dumb" terminal and radio. With this equipment, amateurs could communicate via VHF radio circuits for a reasonable cost. What made packet special? Well, unlike ASCII (a form of Radio Teletype, or RTTY), which had been used on these same frequencies in the past, packet had one big advantage-error detection and correction.

With ASCII transmissions, any irregularity in the signal—noise, poor propagation, interfering transmissions—would cause data loss. The result was usually garbled nonsense and the operator would have to ask for a retransmission. Packet, on the other hand, is always error-free from the operator's point of view. This is because packet radio is based on data "packets," technically called frames, which are managed with an error-detection and correction protocol. In a packet radio QSO, each transmission is broken up into these frames and transmitted along with a "checksum"—a number generated by running an algorithm (set of mathematical operations) against the data in the frame. When the receiving station gets the frame, it runs its own, identical checksum. If they match, the frame is undamaged—if not, the protocol offers a way to ask for a retransmission. In any case, the operator never sees anything but perfect data (though it may take some time).

All this protocol stuff happens in that TNC—now a TNC2—and it talks through an RS-232 port to a terminal, today usually a computer running a communications program. This arrangement was much better than the previous digital modes, and it was quickly adopted. It soon became clear that a bunch of hams running stations with dumb terminals or terminal-emulator software was just not going to cut it. If packet radio was going to live up to its potential, something else was needed.

Hank WØRLI decided that some sort of host system was needed. Something that could store and forward messages and bulletins. WØRLI PBBS (Packet Bulletin Board Systems) soon became the de facto standard for the store and forward systems, and networks with PBBSs appeared all over the country. Today, there are many PBBS packages out there. All of them work hard to interoperate, but the standards involved are more of a gentleman's agreement than the law. Still, all things considered, the packet network works very well.

The problem is that PBBS software expects ordinary AX.25 connections and acts as if the connected station is a terminal. There is nothing inherently wrong with this, and this sort of access will be needed for a long time, since many users will only have a dumb terminal available. On the other hand, many hams are running sophisticated computer systems capable of being PBBSs themselves. These users then run a terminal program which turns their powerful system into a dumb terminal—what a waste!

The Other Possibility

There is a system which runs beautifully over amateur radio and takes advantage of the computer in the shack. It is based on an internationally recognized set of standards, and in the right location can let you literally

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connect to nearly anywhere in Europe and many other places in the world with 5W. When I say connect, I am talking about real-time keyboard-to-keyboard connections.

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What is this system? It's called TCP/IP (Transmission Control Protocol/Internet Protocol) and it is available to the radio amateur in the form of KA9Q NOS (Network Operating System). TCP/IP—often called just plain "IP"—is a protocol for communications and a set of utility programs that offer the services discussed above. Phil Karns KA9Q wrote the seminal version of TCP/IP for amateur radio, and his source code is the basis for all of the available versions today—and there are lots!

The other thing to be aware of about TCP/IP is that it is the standard for communications on the Internet. Yes, the Internet—our present information superhighway. This fact has led to the use of the Internet—which goes everywhere—to connect amateurs from all over the world using "wormholes." These are point-to-point connections over the Internet. To get an idea of the practical effect of this situation, imagine a theoretical ham in Bloomington, IN. This is the location of K9IU, an amateur TCP/IP station connected directly to the Internet. From this location, our ham can connect to Hawaii, Australia, California, Chicago, Holland, and Canada by using a low-power VHF radio.

Now, you can do this with a normal packet station, since the NOS package offers a BBS interface for such connections. But if you run some form of NOS, it is possible to directly interact with resources anywhere on the amateur TCP/IP packet radio network.

Getting Started with TCP/IP

So now you know why, here's what we were doing: JNOS. JNOS is a version of KA9Q NOS, modified by Johann WG7J. This version of NOS was chosen for several reasons, among them:

- It is widely used and available.
- It is feature-rich.
- It is stable.
- It is still being developed—though Johann has chosen to take a break.
- I use it.

To run JNOS, you need the JNOS package. You will find many versions out there and, version 1.07b is the recommended, though not the latest, one. You can get this on the *73* BBS (603-924-9343, 300-2400 baud, 8 data bits, no parity, one stop bit) and many other sources. Check any ham radio BBS that you use—it is most likely there.

You also need a PC, though not anything fancy. An XT will work, an AT is better, a 486 is better yet. You get the idea: the bigger the better. Finally, you need a TNC and a radio. JNOS uses the TNC in "KISS" mode (Keep It Simple, Stupid), so your TNC must have this capability—most do, but check.

The only other thing you'll need is help and patience. The help you can get here and where you live; the patience is up to you. Using JNOS is lots of fun, and it offers much more than the run-of-the-mill packet operation. Keep reading this column as we continue this series.

A Product You Should Consider

There is a product out there that has not gotten the attention it deserves. It is a good idea, is executed well, and is very useful to many hams. The product I am referring to is called the "PC Packet Station."

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The PC Packet Station is a 3/4 PC expansion card with a BayCom 1200 baud packet modem and a 5W two-channel Motorola VHF radio. Plug this board into your PC, load the supplied software, and plug in an antenna—your packet station is on the air. No radio wiring, no TNC wiring, no used-up serial port, and no space taken up in the shack! This may be just what many of you have been looking for. You can also use the unit with TCP/IP by loading the widely available AX25DRV driver for the BayCom modem.

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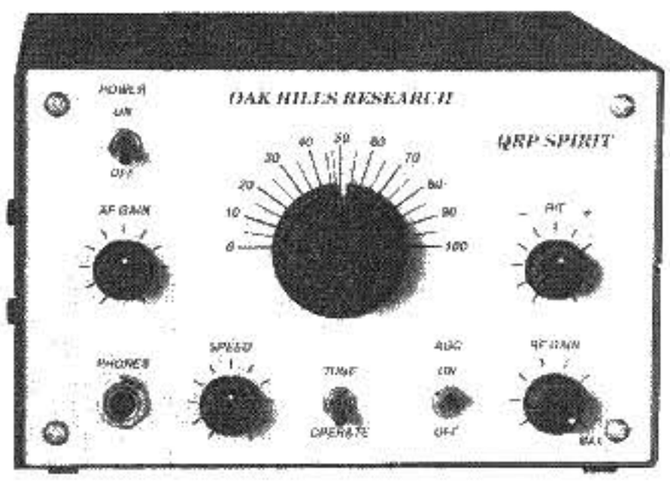

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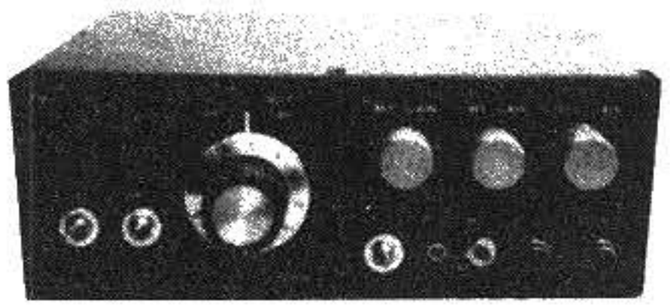

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Getting Started in TCP/IP, Part 7

From Here to There—Routing and TCP/IP

This month's installation of our TCP/IP series will concentrate on routing, the specification of the path that traffic should take between stations.

If I want to connect to your station, but cannot hear it directly, I am not out of luck. The TCP/IP protocol offers the ability to create "routing tables" which specify how traffic addressed to a particular station should be directed. TCP/IP uses what is called "static routing," that is, it depends upon the tables you create to find the intended station for a given address.

ARP

ARP means Address Resolution Protocol, and this is the TCP/IP service that lets JNOS figure out what you mean when you save N1EWO.AMPR.ORG. Let's follow a hypothetical connection by you to my station. We'll use the ttylink (chat) program so we can talk. The first step is for you to type the proper command at the prompt:

```
59872 net>tty N1EWO
```

This tells JNOS to make a telnet connection to port 87 of my station—which is the ttylink service. The first thing your station does is make an ARP request on the air. If we switch to the monitor screen (by pressing F9) we see:

```
AX25:  (your call) ->QST
       UI pid=ARP
ARP:   len 30 hwtype AX.25 prot
       IP op REQUEST
sender IPaddr 44.(your IP
address) hwaddr (your call)
target IPaddr 44.48.70.22 hwaddr
```

Your station is asking the world, "What is the hardware address of 44.48.70.22?" What is a hardware address? TCP/IP is network layer protocol, and in the ham radio world it runs over an AX.25 (plain old packet) link. We use the AX.25 link to create the connection between stations—we use TCP/IP to manage and control data between stations. So, the hardware address is whatever "mycall" is set to for a TCP/IP station. The purpose of the ARP request is to find out what that call is, so communication can take place. TCP/IP is a "datagram" protocol. This is in contrast to a "virtual circuit" protocol such as AX.25. In other words, data transfer via TCP/IP on ham radio is accomplished with AX.25 UI (Unnumbered Information) frames—in plain language, the stations never connect in the AX.25 sense.

By way of example, if we were using NOS over an Ethernet network instead of AX.25, the hardware address that would be sought by the ARP request is the MAC (Media Access Control) address. This is an eight-byte address that is unique to an Ethernet NIC (Network Interface Card), just as "mycall" is unique to an AX.25 station.

Let's assume that my station can hear your station directly. I hear your ARP request and reply (again in the monitor screen):

```
AX25:     N1EWO -> (your call)
          UI pid=ARP
ARP:      len 30 hwtype AX.25
          prot IP op REPLY
sender IPaddr 44.48.70.22
hwaddr N1EWO
target IPaddr (your IP
address) hwaddr (your call)
```

"This month's installation of our TCP/IP series will concentrate on routing, the specification of the path that traffic should take between stations."

As you can see, my station sent a REPLY to yours indicating that my hardware address is N1EWO. It could have been N1EWO-1 or some other SSID (Secondary Station IDentifier, the -1 part). Or, what if I couldn't hear your station—is all lost?

No, there are at least a couple of ways around that. First, I could fix things from my end by arranging a "gateway" and having it "publish" itself as the hardware address to reach me. To make this work takes two steps. First I must use the ARP command (at the gateway station) to publish itself as the hardware address for my station:

arp publish 44.48.70.22 ax25 (gateway hwaddr) (interface)

where:

44.48.709.22 is my address
ax25 is the hardware type
(gateway hwaddr) is the call of the gateway
(interface) is the name of the interface on the gateway that will publish this address.

Now an ARP request for my hardware address will be answered by this gateway station. Trouble is, if I do nothing else this doesn't let us communicate. I need to tell the gateway where to send the traffic that it gets for me. I do this with the ROUTE command:

route add 44.48.70.22 (interface)

Now traffic sent to this station will be sent out the interface specified.

Alternatively, you can set it up from your side. This works by manually adding my station to your ARP list:

arp add 44.48.70.22 ax25 N1EWO (interface)

which puts a permanent entry in the ARP table for me. The second step in this process is to add an AX.25 route to my hardware address using the ax25 command:

ax25 route add N1EWO (interface) (digis . . .)

This puts an entry into the AX.25 routing table for my hardware address, letting you connect. The ARP entry means that you don't have to send out a request—which I could not hear. You can see that TCP/IP routing is "static"—you set it up and then must change it manually. If you can hear the stations directly, it is dynamic (you ask, it tells, your tables are built), but not otherwise.

Next month we'll look more at routing. 73 de N1EWO.

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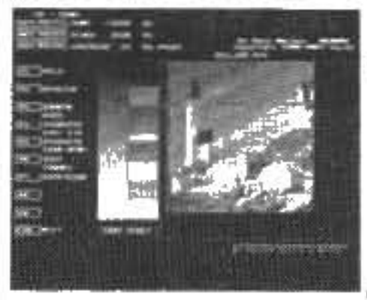

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PACKET & COMPUTERS

Digital Amateur Radio

Jeffrey Sloman N1EWO
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

OK, I'm back after a month's absence. The column tried to compete with moving and lost. Moving is one of my least favorite activities, and this one was worse than expected. On the other hand, we're here and things are smoothing out.

This month I have a few things to deal with, so I will not be doing a "regular" installment of the TCP/IP series. Instead, I need to cover some "administrative" information, and I'll also discuss some IP odds and ends that should be interesting.

First, the administrative. Many of you write to me, both on paper and via the bit stream. I really appreciate hearing from you, and read everything. Replying can be somewhat more difficult. I am not ignoring you. First, I get Email from my other writing work as well, and the combination of *73* mail (you guys aren't shy), and other traffic can be overwhelming at times. I really appreciate all of the feedback—praise and not-praise—but I just don't have a good way to reply to everyone.

Second, many of you have written asking for reprints and executables. I cannot provide these. Reprints come from *73*—call (603) 924-0058 to obtain these; reprints are $3 per article, back issues are $4 each. For the executables, I do not have the time to copy and mail diskettes. Many of you have sent prepaid diskette mailers and disks. I have not been able to do anything with these. You can get any executable or text file I describe on the *73* BBS at (603) 924-9343, 300-2400 baud, 8 data bits, no parity, one stop bit.

Now wait a minute—I know that many of you have tried to find these files on the BBS and they just haven't been there. I must take the blame for this, but I will be changing it.

Now, a personal note to an unknown reader: If you sent me some cash, please write again and let me know who you are. You can identify yourself by telling how much you sent and why. Some time ago, a bunch of mail that included a collection of checks, diskettes, and mailers got separated from the letters that went with them. I do not cash checks sent to me, and I want to return your money.

OK—Here's the last bit of administrative nonsense: how (and how *not*) to contact me. I can be reached three ways:

1. Email on the Internet: This is the preferred method of contacting me and stands the best chance of getting a response. Those of you who subscribe to online services like CompuServe, Genie, AOL, Prodigy, BIX, Delphi, and the like can all reach me at this address. The exact method can vary considerably—get help on your system in addressing mail to the Internet. My Internet address is: jsloman@bix.com.

2. Paper Mail: This is an acceptable way of contacting me if you do not have access to electronic mail (you should, you know). Please write to me c/o *73* magazine, at the address listed above.

3. Packet Mail: Of course I want to hear from you via packet! *But, I cannot answer questions about the column or magazine this way.* Too many of you write to me via packet radio and ask things that, were I to answer, would constitute doing business on the radio. This is *very* frustrating: You have good questions. I am *not* ignoring you, I just *can't* answer—sorry. Please send me packet traffic for fun, to try it, to let me know that you've got something working. But if you want me to respond, don't mention the magazine, *please*. So, with that preamble, address your packet traffic to me at:

N1EWO@NØARY.#NOCAL.CA.USA.NOAM

(Note the NOAM at the end—for North America. Do not use NA, the people in Namibia are not too happy with the folks that do.)

On to other business. First, let me tell you about the latest, and last DOS version of JNOS: 1.10c. WG7J has announced that he is now concentrating on developing a WIN32 version of JNOS (a very good thing indeed), and so 1.10c is the last version that he will release for DOS. Where can you get it? Well, as of this writing you *cannot* get it on the *73* BBS. You *can* get it via anonymous FTP from several of the ham archives. I will avoid specifying a site—this has gotten me in trouble in the past. You should be able to get it from places like CompuServe as well, but I can't guarantee that. JNOS is very widely distributed; ask around.

Version 1.10c adds several features which will be completely new to those of you who are using non-release (x) .10 versions. First, there is a very useful status bar which displays using the top three lines of the display. It offers some nice at-a-glance info:

On the first line—time memory status number of sessions using the various servers (conv, links, bbs, fwd, ftp, smtp), a list of active terminal sessions, specified by number; these blink when there is text waiting in a session not currently displayed.

On the second line is a list of current BBS users by callsign. Each callsign is preceded by a character indicating which activity the user is engaged in.

On the third line is information about the currently-displayed session, including the connection and information about retry timers.

(Users of WNOS are already familiar with this type of status display. This excellent feature is now available to JNOS users.) The status display is configurable in two ways: color and number of lines. The specific colors of the text and background of each line are configurable. You can also choose to display one, two or three lines of status information. Speaking of color, the text display colors are now configurable at startup as well. This is very useful because of another new feature—a command line in the trace window.

You can now execute commands directly in the trace window. This is very useful, for example, when testing using ping. You can ping a station and see the interaction from the very beginning. No more attempts at lightning-fast switches to the trace window with the F9 key are necessary.

There are many other features you will find useful in this new and last version. Get a copy and give it a try—tests here show it being very stable.

TCP/IP Routing Using Digipeaters

You and a friend want to communicate using JNOS on each end; the trouble is, you need to use a digi to make the connection, a digi that doesn't know anything about TCP/IP. Hmmm, how can you make the connection?

The impossibility of using a plain-old-digi for TCP/IP is only a misunderstanding of how the system operates on amateur radio. TCP/IP over ham radio has two different layers. There is a logical layer that handles TCP/IP messages and traffic, and then there is a hardware layer. It is in this hardware layer that the digipeater lives.

When you attempt to connect to a friend's station which *can* hear you directly, the first thing your station will do is to send an ARP request over the default interface. ARP means Address Resolution Protocol, and is the way the an IP station finds out the hardware address associated with the IP address which it has been told. Let's see how this works:

You type "telnet 44.48.70.22" at the JNOS command prompt. JNOS responds by opening a new session window. At the top of the window is the message "Resolving 44.48.70.22." JNOS has just transmitted and ARP request. This is a broadcast message saying, "I need to know the hardware address associated with the IP address 44.48.70.22."

Your friend's station recognizes its address and responds, saying that N1EWO handles IP traffic for 44.48.70.22. Your station places this information in your ARP table, and establishes the connection.

This is the way that it should work, if stations can hear each other. But what if they cannot? In this case we can't rely upon the automatic ARP process, and instead have to make it happen manually. To do this we'll need to make our own arp entries, and also add AX.25 routing information. ARP entries are soft; that is; they will go away when you restart JNOS. To make them "permanent," put them in the AUTOEXEC.NOS.

Here are the facts about the station we wish to reach:

IP address: 44.48.70.22 hardware
address: N1EWO
(note that hardware address=AX.25 address)
digipeater: KB9BWE

So first let's make the ARP entry so that the station does not have to generate an ARP request which could not be answered. We do this from the command line, using:

arp add 44.48.70.22 ax25 n1ewo dsp

arp	the ARP command for JNOS
add	tells JNOS to add the following information to the ARP table
44.48.70.22	the host ID of the station for the entry (this could be alphanumeric [e.g.: N1EWO] if you have the appropriate entry in your DOMAIN.TXT file)
ax25	tells JNOS to use the ax25 hardware layer
n1ewo	the hardware address of the station for this entry
dsp	the name of the interface that should be used for this entry

Now, when you attempt to connect to 44.48.70.22, this ARP entry will be used. So, we're halfway to the solution—JNOS will now use the correct hardware address for N1EWO. What about the digi?

JNOS also maintains a routing list for AX.25 traffic. Using a very similar technique, we add the information about KB9BWE—our digi—to the AX.25 table. From the JNOS command prompt:

ax25 route add n1ewo dsp kb9bwe

ax25	the JNOS AX.25 command
route	the route sub-command
add	tells JNOS to add the following information to the AX.25 route table
dsp	the name of the interface to use
kb9bwe	the name of the digi (more than one can be specified)

Now, JNOS knows everything it needs to about how to reach 44.48.70.22 from your station. When you "telnet 44.48.70.22" it finds the hardware address already in its ARP table and the AX.25 route table tells it to use a digi to get there.

More next month. 'Til then 73 de N1EWO. 73

Number 17 on your Feedback card

PACKET & COMPUTERS

Digital Amateur Radio

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SMTP—The Right Way to do Mail

For the past several months this column has focused on TCP/IP in general and JNOS in particular. For those just tuning in, TCP/IP means Transport Control Protocol/Internet Protocol. That mouthful is a suite of applications that handle communications for the Internet—you know, the "Information Superhighway." [As an aside, there is no such thing as the "Information Superhighway." The term is a political invention, and it makes me slightly ill just to hear people talk about it. It's more like a few interstates, some county roads, and a whole lot of side streets and driveways. This is not to imply that the Internet is without value; it is very valuable. The idea of the Information Superhighway is just political nonsense—the reality is much more complex. Well, enough editorial, let's get back to the real world.]

The Internet was developed by ARPA (Advanced Projects Research Agency—now DARPA, with the D for defense), in cooperation with academe and industry, as a way to promote cooperation in research and on government projects. The Internet project was not just the construction of the physical network to carry the signals, but also the development of the TCP/IP protocol suite. To simplify what is going on there: The TCP portion takes care of moving the data around; the IP portion takes care of packaging the data so it is useful and understood.

SMTP (Simple Mail Transfer Protocol) is the way the electronic mail is sent in the IP world. It is really a simple protocol; in fact, it uses English to send commands back and forth. You can actually send mail as if you were an SMTP server by using telnet (the IP remote login program) to connect to port 25 (IP services are associated with ports, also called sockets; each port provides a different service), and issue a few commands:

```
:telnet host.com 25
Trying...
Connected to host.com.
Escape character is '^]'.
220 host.com — Server ESMTP
(PMDF V4.3-7 #6563)
help
214- Available
214-
214- DATA, EHLO, EXPN, HELO, HELP, MAIL FROM
214- NOOP, QUIT, RCPT TO, RSET, SAML FROM
214- SEND FROM, SOML FROM, TICK, VERB, VRFY
214- XADR, XSTA
214
```

You can see here that I connected to a host and issued the "help" command. Notice the numbers that preceed each line: The text is for humans, and the numbers (220, 214) let automated SMTP servers understand the messages with ambiguity.

OK, so why is SMTP so good? Let's take a look at how it works if you let your system do the work. First, how does "normal" packet mail work? I want to send a message to my friend Mike AA9FP, so I take these steps:

1. I connect to my local PBBS. Depending upon your QTH, this may be easier said than done. As we have discussed before, the LANs (Local Area Networks) in the packet world are generally (mostly) completely unmanaged. Hidden transmitters are everywhere, causing interference and often making staying connected a hit or miss proposition.

I should also point out that my beautiful new 486 machine is now doing the work of a dumb terminal, and probably talking to one of the 386SX machines so often seen as PBBSs. Something is wrong when your $3,500 hot rod is doing the work of a wheelbarrow.

2. While fervently hoping that I will not be disconnected, or make a typo, or get a phone call, or (you get the idea), I type my message. Generally the text reflects my anxiety about the situation (i.e.: it ain't no masterpiece.)

3. I go have a cold drink, and hope that I never have a desire to talk to Mike again.

OK, OK, so I am being dramatic. The point is, the current system causes a huge quantity of unnecessary traffic. It wastes the power of the local computers—even if they are just XTs or 286s, and it is not much fun.

With SMTP the digital ham radio hobby is much more relaxing. Here's how that same message gets sent:

1. I login (locally on my own machine) to my own mailbox.

JNOS (the TCP/IP program we have talked about in this column) provides a full-fledged PBBS which can be used as a personal mailbox or a full-blown PBBS with mail forwarding of the traditional kind. The login process is easy:

```
Trying 127.0.0.1:telnet...
Telnet session 1 connected to
Local BBS
JNOS (n1ewo-9)
Welcome to N1EWO [44.48.70.22]
login: n1ewo
Password:
[JNOS-1.10c-IHM$]
You have 1 message - 0 new.
Area: n1ewo Current msg# 1.
?,A,B,C,CONV,D,E,F,H,I,IH,IP,J,K,L,
 M,N,NR,O,P,PI,R,S,T,U,V,W,X,Z >
```

2. The steps from here are very much like being connected to a "normal" PBBS, just much more relaxing.

One thing that I notice right away is how quickly the machine reacts (I am connected to my own machine and *not* over the air). I also cannot be dumped because of interfering stations. Another difference is addressing. Instead of the normal sort of AA9FP@WJ9U.#CIN.IN, I type:

```
Area: n1ewo >
sp Mike
Subject:
Hello!
```

Enter message. End with /EX or ^Z in first column (^A aborts):

Notice that I called him "Mike." This is because I have a file of aliases that allow me to use names that I understand and remember easily—just a nice convenience. The real difference, though, comes when I finish.

The delivery of SMTP mail is the revolutionary aspect. With the current system, mail is collected by a centralized PBBS then delivered as packages to various distribution points. It finds its way through the system to the destination PBBS and waits for the recipient to connect and check it. (It has become more common for individuals to run similar packages and get their mail directly.)

With SMTP, delivery can go one of two ways. If the recipient is local, the SMTP server (on your machine) will connect directly to the SMTP server on his machine and make the transfer—no third parties involved. It will do this in the background while you do other things, and will keep trying 'til you stop it. It is fun to send your first SMTP mail message and watch the process.

The second possibility is that an SMTP gateway would be used. If the recipient is too far from you to talk directly, a machine locally can be used as a gateway, and the mail will be routed to the destination. This can occur in a batch like the current system or one at a time. A gateway today would very likely resort to the current packet network for the hop in between, and an SMTP gateway on the other end would do the delivery.

Notice that there is no requirement for the recipient to connect anywhere but his own mailbox. This system has a flaw, though. It requires that the recipient's machine be available at all times, ready to receive mail. Not all of us can do that.

POP Goes the Email

The answer to this problem is POP (Post Office Protocol). With POP there is a server in a local area which receives mail for a particular ham—like a PBBS does today. But, instead of connecting to the PBBS and reading the messages, POP is a background batch process. When I start up my station, it checks the POP server for mail and transfers any it finds. All automagically—pretty neat.

OK, fine, but how do I do this?

Well, the first step is to get a copy of NOS (Network Operating System) or a variant. We have been using JNOS—my favorite. It is written by Johann (WG7J) and has reached its final "official" release version 1.10c. Johann is working on a Windows version which should be spectacular. You can get the latest version on the Internet by anonymous FTP to:

```
ftp.ece.orst.edu
in the directory:
/pub/ham/wg7j
the file is:
110exe.zip
```

It should also be available on many ham-radio-related BBSs. You may find earlier versions—these will get you started, but 1.10c has several new features worth having. You may also see releases with later numbers. These are the result of the large following of JNOS users who continue to improve the source code and add features (and bugs, sometimes).

Reprints of this column's discussion of running JNOS are available—call the magazine. We'll discuss more about JNOS in future months. 73 de N1EWO. 73

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Getting Your Computer On The Air

This column usually discusses advanced topics, but even the most advanced among us started out with simple stuff. With that in mind I'd like to get more of you on the air so we can build up the pool of "packet experts."

Many of you with an interest in packet radio are already using your computer to communicate over phone lines using a modem. Sending and receiving data using amateur radio gear shares many of the concepts you already understand from the wirebound world of BBSs. If you are an experienced landline BBS user, you already own one critical component. If you are an average ham, you've got another—a 2m handheld. In fact, for many of you, the only thing that you'll need to buy is a TNC (Terminal Node Controller) which is the packet radio equivalent of your modem (but it's a lot smarter.)

What Do You Need?

The first thing you'll need to start out in packet is some sort of terminal. This can be a "dumb terminal"—an old-fashioned desktop unit often found at hamfests for anywhere from $0 to $20. Almost any dumb terminal will do, *but* not every terminal will work. Ideally, you want something that works as a "glass TTY" (a video version of a printing terminal) or VTxxx emulation, where xxx is 52, 100, 102, 220 (or higher). The VT terminal is an invention of DEC (Digital Equipment Corporation), and is just a little better than dumb. By sending a VT terminal certain command sequences you can get the display to do some interesting things like menus and reverse video, The higher the number after VT, the more modern and capable the terminal.

While a terminal will get you on the air, you'll find it frustrating after awhile. A terminal cannot run the sophisticated communications software that adds to the excitement after you get going. For this, you'll need a computer. Almost any computer can be used in a packet station. If you have a Commodore 64, 128, or Amiga, you'll find lots of other hams using this hardware and ready to offer help. If you use a Macintosh, you'll find plenty of software for your machine. The clear leader, though, in the amateur world will come as no surprise—The IBM-PC and its compatibles.

Just like the rest of the world, hams use the IBM-PC in greater numbers than any other machine. So if you don't own a machine, and you want to buy one for use in our shack—buy a PC. What sort of PC? Well, your best bet is to buy something that will properly run Microsoft Windows. Windows-based ham software is rapidly becoming the norm and offers wonderful ease of use. Basically, you'll want an 80486 with 8 Mb of RAM. Note that this is a very simplistic description, and you'll want to consult an expert (friend or dealer) for a more complete explanation.

Whichever machine you have, you'll be using one of its serial ports to connect the next box in the chain—the TNC. A TNC does two things for you. First, it has some intelligence built in. This allows it to interact with you through its simple user interface. For instance, to connect to another station, you type a command at the prompt:

cmd:c kb9bwe

This instructs the program in the TNC to do everything necessary to make a connection to KB9BWE. To do this it uses a special "protocol"—a set of rules—called AX.25. This is a "packet switched" protocol, and where packet radio gets its name.

Because of this built-in protocol and its "command interpreter"—the part that understands your commands—any sort of communications program will start you out.

The second major function of the TNC is to provide a modem that gets your data on the air. The word modem comes from MODulate DEModulate, and its job is to turn the outgoing digital signal into sound and the incoming sound back into digital information. It functions about the same way that your telephone modem does, but usually at a considerably slower pace of 1200 baud.

Let's take a moment to look at the idea of "baud." This technical term comes from the name of J.E. Baudot, a French engineer who did work on the telegraph. There is confusion about just what "baud" means—it is not the same as bps (bits per second). A baud is a transition from on to off, or logical false to logical true (0 or 1). When we say that a modem is capable of transmitting data at 14,400 bps, we are not saying that it is a 14,400 *baud* modem. The carrier for a 14.4 kbps connection is actually 9600 baud. Thanks to some fancy slight of hand, it is possible to send more than one bit per baud—get that? The modem sends more than one bit of data each time it makes a transition from high to low.

Now, this doesn't mean that you *have* to send more than one bit per baud, and in fact, in the average TNC 1200 baud = 1200 bps. This is somewhat slow for file transfer, but does OK for reading bulletins and keyboard-to-keyboard connections. More hams are looking at higher speed connections, though, and 9600 baud modems in TNCs are more popular than ever.

Choosing a TNC

TNCs come in a range similar to terminal equipment. On the low end are the simple TNC2 (a standard TNC design from TAPR, the Tucson Amateur Packet Radio group, which was greatly responsible for making packet a practical reality). These units can be found at hamfests for less than $100, sometimes considerably less. They can be purchased new for $100 and up. Good units to look for include the AEA PK-88 (and the internal version the PCB-88) probably my first choice in the low end, the Kantronics KPC-4, a nice small unit that is easily powered by a battery for portable use, and the MFJ 1270 which is truly a budget box—not my first choice but it will work and has many happy owners.

It is *very important* to be sure that any TNC you buy at a hamfest is a TNC2 and not a TNC1. While the firmware (on a PROM in the box) can be upgraded on many of these units, it is not the best way to start out your packet carrier unless you have help. Any *new* TNC will be TNC2-compatible. Any of these inexpensive and simple units will get the job done for the beginning packeteer. Once we get past the entry level, though, things start to get very interesting.

Multimode Controllers

Many of you may have your sights set on HF operation and all those esoteric modes like AMTOR (AMateur Teletype Over Radio) and PACTOR (A combination of Packet and AMTOR), or even just plain old RTTY (Radio TeleTYpe). To do these things, you'll need a multimode controller. Multimode boxes come in a wide variety, and choosing one is not a simple matter. I'll give you this advice, though: If you care about HF, buy an AEA unit. AEA is undoubtedly the best in the HF arena with its eight-pole Chebychev filter in the front end. If you want to work digital HF, look for a multimode controller.

The Radio

A transceiver replaces the phone line in our packet connection, and a good radio system is very important to packet operation. The AX.25 protocol uses a traffic control scheme called CSMA/CD (Carrier Sense Multiple Access/Collision Detection). It works a lot like 2M repeater operation:

Carrier Sense—listen before you key up.

Multiple Access—more than one station uses the same frequency

Collision Detection—"hey, you guys doubled"

Because this scheme depends upon all stations on the LAN (Local Area Network) hearing each other (Carrier Sense), your radio must match your LAN. In some places, you just won't get away with less than 50W. This happens when outlying stations make themselves part of your LAN. In order for them to reach stations—usually PBBSs located far from them but close to you—they run high power. This means that even though you could make a good connection with 5W to the station you want to talk to, others on the frequency will not know you are transmitting and will interfere. It is usually possible to find a frequency which supports truly local operations, for those that which to (or must) use handhelds and other low powered radios.

Antenna Selection

I said earlier that you needed a good radio "system." This includes your antenna. If you are inside a LAN service area, you must use a good omnidirectional antenna. For the all-important Carrier Sense part of the AX.25 protocol to work properly, you must hear them and they must hear you. "They" being *everyone* using the frequency, *not* just the station to whom you wish to connect. The fact is, a good antenna can make a dramatic difference in a packet station's performance. I have had a great deal of success with a handheld into a Ringo Ranger at 25 ft., and a great deal of frustration with the same rig into a half-wave mag mount when it was all I could manage. The Ringo is a good choice, or, if you can spend the money, the Fiberglas co-linear designs from Diamond and Comet are simply great. Whichever antenna you buy, follow the mounting and tuning instructions carefully to insure a good VSWR.

What About a Beam?

Directional antennas may seem an attractive alternative to the omni, but they present a problem: Unless you intend a point-to-point link, and your antenna has an amazingly small beam width, *you are going to interfere with other stations*. There is one exception to this: If you live on the fringe of a LAN, and no other LAN user lives behind you (relative to the service area) or nearby to the sides of you, you can point a relatively wide beam toward the LAN. This can and does work in this case, and I am sure that some of you will be able to take advantage of this advice.

Get Help from your Local Hams

The final piece of advice is to seek out a friend in your town, or join a packet radio organization. There is no shortage of help out there, hams love to help others get started in their favorite part of the radio hobby. I'd like to help hams get in touch with individuals or clubs who can help a ham start up with packet. If you are such a person, or belong to such a club, write me on the Internet: jsloman@bix.com and let me know what your up to—I'll let others know here. 73